May 18, 2018

To: Berndt Mueller,
Associate Director for Nuclear and Particle Physics
Brookhaven National Laboratory

Re: Beam Use Request for Advanced Coherent electron Cooling (ACeC)

Dear Berndt,

The CeC group is proposing experimental demonstration of 3D Advanced Coherent electron Cooling (ACeC) of hadron beams in RHIC. This cooler will be based on Plasma-Cascade Amplifier (PCA) of micro-bunching described in our recent paper*: [4] V.N. Litvinenko, G. Wang, D. Kayran, Y. Jing, J. Ma and I. Pinayev, "Plasma-Cascade micro-bunching Amplifier and Coherent electron Cooling of Hadron Beams", arXiv:1802.08677, http://arxiv.org/abs/1802.08677.*

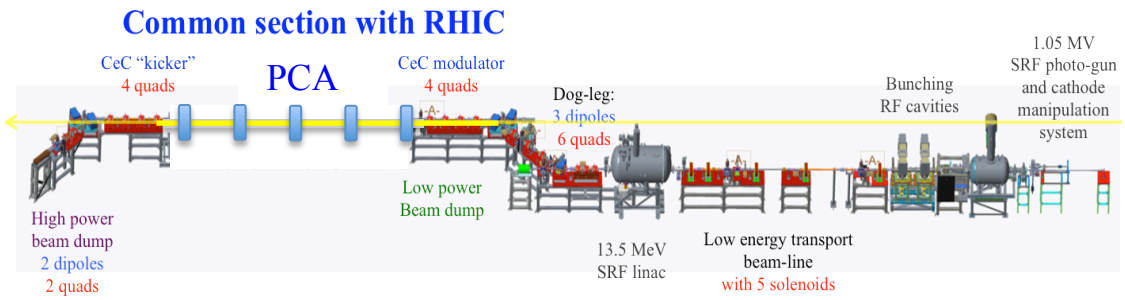

Fig. 1. ACeC with PCA amplifier

This experiment will use the existing CeC accelerator "as is" and a new cooling section, which is located in IP2 and is common with RHIC beams. This cooling section with 4-cell PCA (comprised of 5 solenoids) will replace the currently used CeC with FEL amplifier. The later limits the IP2 aperture to 28 mm and is incompatible with low energy operation of RHIC in FY19-21 and cooling by LEReC. In contrast, the new system had been designed with aperture sufficient for LEReC: its transverse aperture were defined by Dr. Wolfram Fisher. New structures related to ACeC had been designed and are in process of procurement using my SBU funding.

We plan all critical elements common with RHIC to be installed during this shutdown. We anticipate to tune the CeC accelerator beam to satisfy requirements needed for PCA during RHIC Run 19. This process will be done in parallel with RHIC operation and will not require any dedicated time

Additional elements, which can be mounted independently (such as trim dipoles) to be added either during Run 19 maintenance days or during RHIC shutdown in 2020. We plan to demonstrate longitudinal micro-bunching coherent electron cooling (PCA-based ACeC) with 26.54 GeV/u Au ion and proton beam in RHIC. This will require up to one week of dedicated beam time.

In contrast with other proposed schemes, our PCA-based ACeC does not require separating electron and hadron beams – the approach that could save tens of millions in cost of future eRHIC. As identified by the most recent eRHIC pCDR review committee "The major risk factors are strong hadron cooling of the hadron beams to achieve high luminosity, and the preservation of electron polarization in the electron storage ring. The Strong Hadron cooling [Coherent Electron Cooling (CeC)] is needed to reach $10^{34}/(cm^2s)$ luminosity. Although the CeC has been demonstrated in simulations, the approved "proof of principle experiment" should have a highest priority for RHIC." The goal of this request is to address this challenge in the most expedient and the most cost effective way.

Hence, I am sending you this request for 7 days (336 hours) of dedicated RHIC beam time to conduct this experiment. I will be glad to answer any questions you have related to this request,

Sincerely yours,

Vladimir Litvinenko

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